Neonatal Transport

Oxygen Therapy for Acute Myocardial Infarction

Spinal Immobilisation in Penetrating Trauma: is there a Benefit?

Brief Extracts of Research Relevant to Pre-hospital Emergency Care
This issue marks an important point in the development of Sanguine. Since 2011 (yes, Sanguine is now in its fourth year of publication) I have been responsible for editing and producing each issue. In 2013, a Steering Committee was established to broaden the input and sharing of responsibility for contributions and editing and this has been very successful, however I have decided now to step down from Chairing the Steering Committee and being the Editor of Sanguine and to hand over these portfolios to the Society’s Vice-President Michael McCaul.

I am absolutely confident that Michael will not only continue to produce quality issues of Sanguine every six months, but also that he will plot a new and exciting course for this publication and give it the strategic direction that it has needed for a long time. Judging by the ideas that have already been discussed in the first half of this year, leading up to this issue, I believe that the next few years will see some exciting developments in both the nature and content of Sanguine and in the development of broader participation in its development and content. I wish Michael well in taking over as Editor and trust that you will support both the publication as it grows and his efforts to advance and improve it.

Chris Stein
Outgoing Editor

A good leader is not someone who makes himself indispensable; it’s quite the opposite. When it is time to move on, a great leader will say, “You don’t need me anymore, you can go further without me now.” Thank you, Chris, for being a great leader. Sanguine has been through four years of moving from strength to strength and has not ceased growing since its inception. I have the honour of working side by side with an experienced and expanding editing team. As Chris mentioned, Sanguine will see some new developments and we are very excited to share these with you in the up and coming issues.

In this issue we showcase a variety of clinical topics and news pieces. We have an interview with the designers of the TOMPSA app, debate critical reflection in emergency care education, investigate the effectiveness of oxygen therapy in acute myocardial infarction, discuss neonatal transfers, review the future of spinal immobilisation and among other topics, highlight recent literature pieces in \textit{en passant}.

Michael McCaul
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Sanguine: Biannual publication of the Emergency Care Society of South Africa (ECSSA)

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Sanguine publishes newsworthy and professionally relevant articles of interest to all healthcare professionals working in the field of pre-hospital emergency care. The views expressed in Sanguine are not necessarily those of the Editor or ECSSA. Information related to the clinical assessment, diagnosis or treatment published in Sanguine should not be regarded as any form of guideline unless explicitly identified as such.

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SOCIETY NEWS

ECSSA 2014

The Emergency Care Society of South Africa is once again organising the Prehospital Emergency Care Conference

This year it will be held in the epicentre of human evolution – The Cradle of Human Kind at Maropeng, in the West of Johannesburg. This is in keeping with the theme of the conference: First Contact to Final Outcome: The evolution of prehospital emergency care. ECSSA 2014 is the only conference dedicated to prehospital care in South Africa. It will see industry leaders and international delegates coming together to engage in interesting discussion and stimulating debate on topics such as paediatrics, trauma, intensive care transport, research, education and rescue. The conference will take place from the 18th to the 20th of September 2014. For more information and to register please visit http://www.ecssa.org.za/conference.aspx.
Western Cape Government Health Emergency Medical Services: Implementation of New Computer Aided Dispatch System

The Western Cape Government Health Emergency Medical Services (EMS) is currently implementing a new state of the art Computer Aided Dispatch (CAD) system, as part of its EMS Evolution Project. The CareMonX CAD, which forms the foundation of the EMS Evolution project, includes features that will optimise EMS performance and provide information to strategically plan for growth of the service within the province.

These features include:
- Automatic Vehicle Location
- Enhanced Route Planning
- Vehicle Dispatch Suggestion (based on time to incident utilising distance, traffic information and other factors)
- Virtualised Communications Center technology (allowing for all emergency calls to be managed throughout the province, regardless of where they originate from)

The EMS Evolution project also includes the implementation of Mobile Data Terminals (MDTs) and Patient Data Terminals (PDTs), which allow for the improved operations of ambulances, better information for crews and more comprehensive clinical notes.

Through the implementation of the EMS Evolution solutions, EMS aims to improve its service to the citizens of the Western Cape and ultimately improve emergency medical care to those who need it most.

Dr Julian Flemming
Emergency Medical Services
Western Cape
BOOK REVIEW

AFEM HANDBOOK OF ACUTE AND EMERGENCY CARE

Lee A. Wallis and Teri A. Reynolds

The AFEM Handbook of Acute and Emergency Care focuses on providing a quick reference and easy to use information for any allied health care provider in the emergency setting. The handbook focuses on providing practical information for the practitioner in the African context. A useful perk of the handbook is the Rapid Assessment Protocols (RAPs). RAPs is a lay open and use (two facing pages) emergency care guidance algorithm designed to be used at the bedside. There are over 25 RAPs and they provide the clinician with the needed information (step by step) in an emergency on a variety of topics from abdominal pain in children to anaphylaxis. 6 clinical themes complete the handbook which include the approach to the unstable patient, disorders by system, emergency ultrasound, procedures, special considerations and lastly RAPs. The procedures section is to the point and some are supplemented with figures.

The handbook provides readers with resource specific information by indicating interventions, test or procedures as applicable in either moderately (well-stocked district or small regional hospitals) resourced settings or fully resourced settings (large national or large regional hospital). The appendix section further supplements the main text with reference material such as acid-base algorithms, how to read a chest x-ray and antibiotic guidelines. The book can also be used as part of a broader emergency care education programme and is coordinated with an open-access emergency care curriculum and associated presentation bank.

Despite the handbook being rather bulky it provides what it set out to provide: a concise, easy access and practical guide for emergency care practitioners whether you are a doctor, nurse or paramedic.
Towards Safer Neonatal Transport: Oxygenation and Ventilation: A Summary

Willem Stassen

Traditionally, the belief was that if a little is good for the patient, a lot more must be better. Oxygen was no exception. However, in modern times it has been discovered that, when it comes to oxygenation and ventilation of the neonatal population perhaps less might be more.

One in ten children will die before their fifth birthday if born in Sub-Saharan Africa. In 2009 the South African under-five mortality rate was 50.7 per 1 000 live births. In South Africa, as with many parts of the world, specialised neonatal units are generally centralised to tertiary and university institutions in the urban areas. Literature clearly defines the benefit of specialised neonatal services and referral to higher volume units on infant mortality. Transfers to specialist units therefore rely on skilled EMS personnel to stabilise and transport these high-risk patients. For this reason it is essential to be abreast of the latest trends in neonatal oxygenation and ventilation as these, when poorly executed, might have a significant influence on patient morbidity and mortality. The aim of this summary review is to provide information on ventilation and oxygenation in the neonatal population, specifically targeted at the prehospital professional.

Oxygen Therapy

Oxygen therapy and ventilation are important components in the care of premature and term infants alike. Just as too little oxygen is detrimental to the infant, too much oxygen is toxic. These toxic effects are products of high inspired oxygen concentrations and high arterial oxygen contents.

On inspiration, oxygen diffuses into the pulmonary capillary blood and yields a PaO\(_2\) of 150mmHg, which is much higher than that in venous blood (40mmHg) – ensuring a diffusion gradient. The diffusion of oxygen is viewed by the oxygen-haemoglobin dissociation curve, illustrating that as the saturations move towards 100%, the PaO\(_2\) becomes less predictable. Should oxygen be required, it should be delivered in a humidified and warmed form, using an oxygen blender to ensure exact oxygen concentrations.

Oxygen Delivery Devices

Continuous Flow Nasal Cannula: Oxygen concentrations via N/C cannula cannot be directly determined as it represents a uncertain mixture of oxygen delivery and room air (inspired through the nose). Using standard N/C also poses limited humidification.

High Flow Nasal Cannula (HFNC): HFNC is continuously being used instead of CPAP to provide continuous alveolar distending pressures – especially during transport. It is not possible to measure this pressure – which is mostly determined by the open/close status of the infant’s mouth. In one study, the airway pressure was found to be negligible when the infant’s mouth was open.

Ventilation: Another way of delivering supplemental oxygen to patients is through mechanical ventilation which will be discussed later.
**Hyperoxia**

The deleterious effects of hypoxia are well known, yet hyperoxia (high blood oxygen concentrations) can be just as toxic. Hyperoxia may occur whenever the fraction of inhaled oxygen exceeds the normal atmospheric ratio of 0.21 (or 21%). Oxygen produces its harmful effects by transformation into oxygen free radicals which promote destructive inflammatory processes and apoptosis (genetically programmed cell death). The lungs are particularly prone to these effects as they experience the highest oxygen concentrations in the body.

Some of the clinical consequences of hyperoxia are:

- **Absorptive atelectasis:** High oxygen content displaces nitrogen from the terminal alveoli and replaces it. Oxygen diffuses into the blood stream and finally causes absorptive atelectasis. These effects are particularly pronounced in the ventilated patient (who is unable to take vital capacity breaths or sigh due to sedation or chemical paralysis), in patients who have greater oxygen usage due to increased metabolic demands or those with surfactant deficiencies.

- **Accentuation of hypercapnoea:** Occurs in patients with chronic compensated respiratory acidosis because oxyhaemoglobin has a lesser affinity for CO₂ than deoxyhaemoglobin – the Haldane Effect.

- **Airway Injury:** Airway erythaema and oedema can be observed within 6 hours of breathing at oxygen concentration levels of 90%. What is more concerning is that oxygen free radicals are already present in expired air after breathing 28% oxygen for only one hour. Another study found that healthy volunteers experience pleuritic chest pain, cough and dyspnoea after breathing pure oxygen for 24 hours. Bronchopulmonary dysplasia and hyperoxic bronchitis are manifestations of this injury. High FiO₂’s have also been associated with the development of ARDS.

- **Extrapulmonary Toxicity:** Retrolental fibroplasia is one of the major concerns in high oxygen concentrations in neonates – its incidence and severity have been associated with the duration of PaO₂ > 80mmHg. Cardiovascular effects of hyperoxia include coronary vasoconstriction, microscopic foci of necrosis in the myocardium, increased systemic vascular resistance, reduced stroke volume and cardiac output and even bradycardia. Hyperoxia may be prevented by oxygen titration. Oxygen concentrations should be titrated to the lowest FiO₂ tolerable to a PaO₂ of 60-65mmHg (SpO₂ of approximately 90%). During ventilation, oxygen requirements can be reduced by:
  - Administration of PEEP.
  - Prone positioning.

- **Alternative ventilation modes:**
  - Inhaled nitric oxide.
  - Extracorporeal Membrane Oxygenation.
  - Diuresis if pulmonary oedema is present.
  - Adequate bronchopulmonary hygiene and regular suction as required.

**Measuring Oxygenation**

It is essential to measure oxygenation and oxygen therapy in all neonates that require supplemental oxygen in order to avoid both hyper- and hypoxia. Some of the ways of measuring oxygenation and their limitations are discussed below:

- **Arterial blood gas:** The gold standard of determining oxygenation. However, it provides a static measure of oxygenation at a single point in time and does not allude to any fluctuations that might occur in many patients (especially in congenital cardiac defects). Sampling may also be difficult often times and an arterial catheter is preferred in cases where frequent sampling is required. Air bubbles and blood dilution with heparin may yield inaccurate results.

- **Pulse Oximetry:** Provides continuous noninvasive oxygen concentration measurements. Motion artefact, ambient light and improper placement all contribute to error in pulse oximetry. Additionally, certain physiological
states such as hypoperfusion, anaemia, hyperoxia and severe hypoxaemia might also cause inaccurate results that do not correlate with the PaO₂.

**Target Oxygen Ranges**

The ideal target ranges for neonatal oxygenation is still poorly defined, and will depend on the fraction of foetal haemoglobin (HbF). Because HbF has a higher affinity for oxygen, the actual oxygen content in circulation may not change much more when PaO₂ levels are greater than 50mmHg. Conversely, saturation levels with a PaO₂ less than 50mmHg might still be falsely acceptable.

One trial that attempts to establish the target SpO₂ ranges for neonates randomised 649 subjects to either maintain saturations between 96% and 99% or 89% to 94%. The higher SpO₂ group were more likely to remain hospitalised, on supplemental oxygen and to develop lung disease and pneumonia. Other studies corroborate that values less than 89% and higher than 95% are both associated with complications and increased morbidity and mortality.

**Mechanical Ventilation**

Mechanical ventilation of the preterm infant and other neonates is a multi-faceted and complicated topic that is determined by the patient’s gestational age, lung dynamics, comorbid factors, congenital defects and underlying condition. This section is therefore by no means exhaustive, but aims to merely highlight some of the latest developments in neonatal ventilation and make recommendations for standard practice.

Ventilation of neonates is beneficial because it decreases the work of breathing, improves lung recruitment thus limiting ventilation/perfusion mismatch and provides ventilation during apnoea.

Ventilation is usually commenced when respiratory failure does not resolve despite nasal CPAP at oxygen concentrations greater than 70%. In the neonate, respiratory failure is defined as respiratory acidosis (pH < 7.2, PaCO₂ > 60mmHg), a PaO₂ < 50mmHg or severe and persistent apnoea.

Ventilation is often required in the following conditions:
- Respiratory distress syndrome
- Apnoea of prematurity
- Infection
- Post-operative recovery
- Persistent pulmonary hypertension
- Meconium aspiration syndrome
- Congenital anomalies

**Principles of Ventilation**

- **Ventilator Mode**: The mode of ventilation refers to whether the breath delivery is synchronised or not synchronised with the patient’s own respiratory efforts, and whether ventilation is via an endotracheal tube or a non-invasive face or nasal mask.
- **Ventilator Cycling**: Cycling refers to which variable causes a current breath to end and a new breath to start. Cycling can either be set to tidal volumes, inspiratory pressures or time.
- **Ventilator rate**: The amount of breaths that the ventilator will deliver in one minute.
- **Tidal Volume (TV)**: The amount of volume of air (in millilitres) that the ventilator will deliver at each breath. May be used as a cycling method in volume modes.
- **PEEP**: Positive End-Expiratory Pressure is the pressure that remains in the lungs after the patient has exhaled.
- **Minute Volume**: The volume of air that the patient receives in one minute. TV x Rate = MV.
- **Inspiratory Pressure**: The pressure delivered to the patient to cause inspiration and a tidal volume. It may be used as a cycling method in pressure modes.
- **Respiratory times**: The inspiratory time refers to the time in seconds that it takes to inhale. The expiratory time refers to the time in seconds that it takes to exhale.
- **I:E ratio**: The I:E ratio is the ratio obtained when the inspiratory time is divided by the expiratory time.
- **Trigger/Sensitivity**: The trigger or sensitivity is the magnitude of the respiratory effort that the patient has to make in order to trigger a ventilatory breath. This trigger might be a change in pressure or a change in volume.
- **Ventilator Limits**: The ventilator limit, usually a pressure limit, is that pressure at which the ventilator will cease giving a breath, and change to the exhalation phase of the respiratory cycle.
- **Pressure Support**: Pressure support is additional support given to each spontaneous breath above the set mandatory breaths.
- **CPAP**: Continuous positive airway pressure provides an uninterrupted pressure to the airway during both the inspiratory and expiratory phases of respiration, thus keeping the alveoli open for gaseous exchange.

**Modes of ventilation**

Four major modes of ventilation (controlled, synchronised, noninvasive and high frequency ventilation) will be discussed. Pressure, volume and time-cycled ventilation will also be touched on.

**Controlled ventilation**

Controlled or mandatory ventilation (CMV mode) involves the setting of a minimum amount of breaths per minute that the ventilator delivers regardless of the patient’s own respiratory efforts. These breaths might therefore be superimposed on the infants own exhalation and is not synchronised. The most popular type of controlled ventilator is a time-cycled-pressure limited (TCPL) ventilator which requires the operator to set a inspiratory and expiratory time (which determines the I:E ratio and ventilator rate) as well as a pressure limit (which would terminate a ventilator breath should this limit be reached). PEEP may or may not be added. Despite the fact that TCPL ventilation is relatively easy
to use it has poor synchrony, tidal volumes and inspiratory pressures cannot be guaranteed, and causes an increased work of breathing during spontaneous respiration. These in turn might translate to fatigue, higher metabolic demands, barotraumas, volutraumas and ARDS. Asynchrony has also been associated with an increased risk for intracerebral haemorrhage.

**Synchronised ventilation**

During synchronised intermittent mandatory ventilation (SIMV), the patient is allowed to trigger the mandatory or ventilatory breaths by overcoming the set sensitivity – either by creating a negative pressure or a negative flow. The set ventilatory rate will be delivered in synchrony with the patient’s own spontaneous breathing. Should the patient become apnoeic, the ventilator will not wait for a trigger and deliver the breath irrespective of the patient’s respiratory efforts. The ventilatory breaths can be cycled by setting a tidal volume or an inspiratory pressure. The pressure may also be limited, and PEEP can be added.

The addition of pressure support (PS) will improve the intermittent spontaneous breathing by providing added pressure to overcome the resistance of the endotracheal tube and the ventilator circuitry. One randomised controlled trial comparing SIMV with PS and SIMV without PS found that the group with PS were less likely to require ventilation at 28 days after life (47% vs. 69%).

**Noninvasive ventilation**

Noninvasive positive pressure ventilation (NIPPV) provides ventilation through a face mask or nasal prongs, thus negating the need for endotracheal intubation and mitigating its complications. Despite the fact that literature on this topic is lacking, a few studies demonstrate a benefit. In one randomised, controlled trial published in 2011, 200 infants were randomised to either receive NIPPV or nasal CPAP after being diagnosed with RDS. More than half the amount of infants in the NIPPV group did not require intubation within 24 to 72 hours (10% vs. 22%) when compared to those treated with CPAP. Another study among 76 neonates corroborated these findings suggesting that NIPPV can be safely used (and is more beneficial than CPAP) when a more conservative approach to RDS management is warranted.

NIPPV has been used effectively in apnoea of prematurity, following extubation and as primary ventilation mode in RDS.

**High frequency ventilation**

High frequency oscillator ventilation (HFOV) delivers very small tidal volumes at a rapid rate (300 – 1500 breaths per minute). When comparing HFOV with conventional ventilation as primary mode of ventilation HFOV shows no benefit over conventional ventilation. When using death and incidence of intraventricular haemorrhage and BPD as outcomes. This was demonstrated in two meta-analyses of 25 trials that including a combined subject total of 6814 infants. Studies suggest however, that HFOV can be considered when conventional ventilation fails.

**Pressure vs. volume**

When comparing the different modes of ventilation, a Cochrane Review of twelve trials (includes in excess of 700 infants) concludes that volume-targeted ventilation has a reduced incidence of death, BPD, pneumothorax, and intra-ventricular haemorrhage compared to pressure limited ventilation. This can mainly be attributed to the implication of volutrauma in the development of BPD.

**Patient positioning**

Another Cochrane Review of eleven trials (206 infants) found that the prone position of ventilation was associated with better oxygenation however, clinical outcomes were not reported on and the effect of patient positioning on morbidity/mortality is yet to be determined.

**Standard Ventilation Settings**

The standard ventilation settings depend on the experience of the paramedic and the patient’s individual condition. However, the following might serve as a guideline.

- **RR:** See normal ranges later
- **TV:** 4-6ml/kg. One study suggests that the work of breathing is less when 6ml/kg is chosen over smaller volumes. It is essential to interpret these recommendations in conjunction with the pressures and chest wall movement.
- **FiO₂:** Lowest limit tolerable
- **Pressure Limit:** 25-30cmH₂O
- **Pressure Support:** 30% – 50% of the difference between Peak Inspiratory Pressure and PEEP.
- **PEEP:** Patient dependant, normally 3-5cmH₂O.
- **I:E ratio:** 1:2

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SPINAL IMMOBILISATION IN PENETRATING TRAUMA:
IS THERE A BENEFIT?

Chris Stein

Treatment of penetrating injuries to the head, neck or torso is a common part of pre-hospital emergency care for all emergency care personnel of all qualifications and scopes of practice. This treatment sometimes involves spinal immobilisation as a “precaution”, because of the perceived risk of unstable spinal injuries. The decision to immobilise must be made with due consideration of the real risk of doing further harm, and the risk of complicating other aspects of patient care.

South Africa, with an incidence of traumatic injury that is amongst the highest in the world, also has a high incidence on injury due to interpersonal violence. Consequently, the treatment of penetrating trauma is an every-day event for emergency care personnel in most areas of the country. Guidelines for spinal immobilisation are not contained in the Health Professions Council of South Africa’s protocols, consequently the taught approach to who should be immobilised and under what circumstances varies. Mostly, the teaching is that spinal immobilisation is required when a patient’s mechanism of injury suggests the potential for cervical spine or spinal cord injury, without differentiation between blunt and penetrating mechanisms.

Penetrating Injury and Cervical Spine or Spinal Cord Injury

The incidence of cervical spine and spinal cord injury in cases of penetrating trauma has been the focus of a number of research studies, with the first such large study reported 16 years ago. In this study, all patients with gunshot wounds to the head occurring over a five year period (between 1990 and 1995) were identified from a US trauma registry. Details recorded for each case included Glasgow Come Scale score, other injuries, x-ray investigations, autopsy results and whether or not the patients were immobilised before transportation to hospital. Results indicated that cervical spine clearance, either clinically or after x-rays, was possible in 93% of cases (199 of 215 patients in total). Three patients had bony cervical spine injuries, two without neurological deficits (the third was identified at autopsy). In each of the these three cases, entry or exit wounds indicated a projectile trajectory involving the cervical spine. In 84% of these cases, patients were immobilised before transportation.

A smaller study conducted in Scotland used a similar method and came to similar conclusions. Patients in a trauma registry identified as having penetrating injuries and spinal cord injuries occurring between 1992 and 1999 were studied. Only 12 such cases were identified, 10 were assault victims and in nine of these a sharp object was used (only one was a gunshot wound). In all cases there was either obvious clinical evidence of a spinal cord injury or the patient was encountered in cardiac arrest. In all cases, these patients were immobilised before transportation to hospital.
A similar military study, involving UK combat injuries with penetrating neck trauma, yielded analogous results, although mechanisms were different (mostly due to explosions, with roughly a quarter of gunshot injuries). Cervical spine injuries occurred in 22%, but only 7% reached the hospital alive and one had an unstable cervical spine injury. Pre-hospital spinal immobilisation was unreported.6

A US retrospective review incorporating 24,246 patients with penetrating (gunshot and stab injuries) and blunt mechanisms. The rate of cervical spine and spinal cord injury were significantly higher in the group with penetrating mechanisms than in those with blunt mechanisms (and highest in those with gunshot injuries). In the penetrating mechanism group with cervical spine or spinal cord injury, cases had either neurological signs or other signs of injury and the spinal cord injuries that occurred were considered to be complete at the time of injury.10

Having considered the above data, what can we conclude about the risk of either cervical spine or spinal cord injury from penetrating mechanisms involving the head and neck (which are most commonly categorised as either gunshot or stab injuries)? All of the studies above suggest that this risk is very low. Furthermore, the broad category of “penetrating injury” is not really appropriate as the injuring potential of stab wounds is very different to that of gunshot wounds when considering the risk of spinal injuries. Gunshot or stab wounds to the head and neck that do result in spinal injuries can generally be identified by external signs (i.e. stab/gunshot wounds in close proximity to the neck) or neurological signs and these injuries are typically complete at the time of injury with little or no potential for movement of the head and neck to worsen them.

Complications of Immobilisation in Cases of Penetrating Trauma

The decision to immobilise patients in whom spinal injury is not obvious is most often based on the assumption that this procedure is a precaution that “can’t do any harm” and is thus justified even if the actual risk of an underlying injury is low or very low. Currently in pre-hospital care an approach of being “safe rather than sorry” is applied. This would be reasonable, except for the fact that it is incorrect to consider spinal immobilisation to be harmless, and particularly so in seriously injured patients. Even though it seems to be a benign, basic procedure, spinal immobilisation typically complicates patient care and it is these complications that require careful consideration of the risk: benefit ratio in cases where a penetrating mechanism of injury is present.

Two major potential complications arise from spinal immobilisation in critically injured patients (who are the same group that immobilisation is most likely to be applied to). The first is the well-known effect that in-line spinal immobilisation has on the difficulty of airway management, in particular endotracheal intubation (ETI). It is well known that laryngoscopy with in-line immobilisation complicates the procedure of endotracheal intubation and that success rates of ETI can be significantly lower under these circumstances. A number of the studies cited above have emphasised this point.5,8,10,11 The second is the effect that the procedure of spinal immobilisation has on scene-time, with the decision to immobilise leading to unavoidably longer delays before patient transportation can begin.5,7,11 In addition to these two potential complications, the application of a cervical collar early on during patient care tends to prevent ongoing visual assessment of the neck and this too may complicate the management of patients with penetrating injuries in this anatomical area.8
Recommendations

The Prehospital Trauma Life Support Executive Committee has published a review and set of recommendations on the use of spinal immobilization in penetrating trauma in order to align clinical practice with scientific evidence. The findings and recommendations of this group are as follows:

- There is currently no evidence to support routine spinal immobilization in cases of penetrating injuries to the cranium, neck or torso (this applies to a single-mechanism situation and does not apply to mixed penetrating and blunt mechanisms).
- Spinal immobilization may be performed when a neurological deficit is encountered on clinical examination. Even in these cases however, the benefit of immobilization is questionable as all of the available evidence points to the immediate and complete injuring that occurs at the time of the causative process.
- Spinal immobilization should never be prioritised higher than other life-saving procedures in the treatment of patients with penetrating injuries.

Does this mean that we should dispense with the immobilisation equipment whenever there is a penetrating mechanism of injury involved, as a rule? No, the above recommendations provide guidance but should not be seen as a rule. Careful history taking, clinical examination and logical decision-making are still necessary to provide safe and effective treatment, particularly when ascertaining the sequence of events that lead to injury as these may not be limited to a single mechanism.

References


Chris Stein is an Emergency Care Practitioner and Senior Lecturer in the Department of Emergency Medical Care at the University of Johannesburg.
Critical reflection is an important part of both transformational learning and experiential learning, cornerstones of EMS education and training in South Africa. Experiences do not necessarily lead to learning without exercising critical reflection: the aptly named Criticos\(^1\) philosophises poetically that “effective learning does not follow from positive experience but from effective reflection”. So what is effective, or critical, reflection?

Merriam \textit{et al.}\(^2\) calls it a “cognitive process” where we do not settle for a superficial recollection of an experience, but “examine the underlying beliefs and assumptions that affect how we make sense of an experience”. Three separate types of reflection are elucidated by Mezirow\(^3\), namely:

- **Content reflection** – simply thinking about the events within an experience;
- **Process reflection** – problem-solving and “thinking of ways to deal with the experience”;
- **Premise reflection** – involving the examination of deeply embedded “socially constructed assumptions, beliefs, and values about the experience or problem”.

In that same passage, Mezirow asserts that it is only premise reflection that causes significant and transformative learning.\(^4\) Similarly, from a schooling perspective, York-Barr, Sommers, Ghere and Montie\(^4\) talk about reflective practice:

\textit{“a deliberate pause to assume an open perspective, to allow for higher-level thinking processes... examining beliefs, goals and practices, gain[ing] new or deeper understandings that lead to... changes in behaviour, skills, attitudes or perspectives.”}\(^4\) (pp 172)

However, the application of reflective practice and encouragement of critical reflection are potentially limited by filtration through the values and belief systems of the educator themselves\(^2\) and depend on whether the educator views the practice as “liberating or domesticating.”\(^2\)

Merriam \textit{et al.} states that “the outcome of reflection is to gain deeper insights that lead to action”\(^2\) (pp 173), which, by extension, prompts additional reflection, change and more action. The timing of this reflection may impact on the quality of the learning and the resultant action. Two timings have been recognised: reflection-on-action (thinking about the experience after it’s happened, which brings about changes for future application) and reflection-in-action (analysing during the experience, which may cause on-the-spot adjustment within the current experience).\(^2\)

The application of critical reflection in EMS training and education is both valuable and needing additional emphasis. It is ideally a technique which may have been introduced in high school education, and can be leveraged effectively to improve learning and performance during skill practice. However, in my experience, it is apparent that this is a new concept to many students and the facilitator needs to constantly prompt for this reflection.

Remember that just having the experience does not guarantee any learning has taken place – you, the facilitator, must highlight the...
clash of the current experience with the student’s existing knowledge, which the student must then integrate into their current knowledge (or indeed totally replace it) through deep consideration and reflection. This process can be ingrained by repetition and concerted application during the educational program, with the facilitator giving progressively subtler prompts for reflection, the eventual goal being the learner exercising critical reflection in not just their professional practice, but also their citizenship, family and personal lives.

References:
The Cochrane Corner highlights Cochrane relevant systematic reviews of relevance to the South African emergency medical care community, and aims to provide insightful commentary and emphasize implications for practice in South Africa. In this issue, we feature the Cochrane review on oxygen therapy for acute myocardial infarction conducted by Cabello et al which has been recently updated.

**OXYGEN THERAPY FOR ACUTE MYOCARDIAL INFARCTION**

Cabello JB, Burls A, Emparanza JI, Bayliss S, Quinn T

Oxygen therapy is given routinely to patients diagnosed with acute myocardial infarction (AMI) by paramedics in the pre-hospital setting and during hospital stay by physicians. Standard therapies such as these, are often based on expert opinion, physiological reasoning and tradition. Oxygen therapy in these emergency situations is rarely questioned, as long as it does no harm - surely it is good for the patient. However, can we truly say oxygen therapy is harmless?

A team from Spain and the UK have undertaken a Cochrane systematic review investigating whether giving routine oxygen to patients with suspected AMI (ST-elevation myocardial infarction (STEMI) and non-STEMI) does more good than harm by reviewing evidence from randomised controlled trials. The authors carried out a systematic and comprehensive search on the 7th of April 2013. They included trials comparing adults with suspected or proven AMI (STEMI or non-STEMI) receiving oxygen compared to air or air with titrated oxygen if desaturation occurred. Studies investigating hyperbaric or aqueous oxygen therapy was excluded. The authors sought patient centred outcomes specifically mortality and pain. A total of 4 studies (430 patients) were included.

Of the 4 studies, 3 compared inhaled oxygen at 4 to 6 L/min (given by mask [3 studies] or by nasal cannula [1 study] versus a control therapy (air [3 studies] or titrated oxygen aiming to saturate between 93%-96%). For the 3 studies the pooled relative risk (RR) for mortality was 2.05 (95%CI 0.75 to 5.53). Part of the reason why there is such a large confidence interval is due to the small amount of patients included (n=430) and the small number of events, only 16 death were recorded. However, the study by Ranchord (2012) excluded two patients who developed cardiogenic shock after randomisation, it is unknown in which groups these patients were allocated and what their outcomes was. A worse case scenario sensitivity analysis by the authors indicated that if these patients died and were allocated to the control arm the pooled RR would swing around to 0.26 (95%CI 0.03 to 2.31), a protective effect. This indicates the volatility of small event rates in meta-analysis and the caution that must be applied with interpretation of this data. So, is the two fold increase in mortality from...
oxygen therapy a warning sign that did not have enough statistical power to be detected or play of chance? Or on the other hand, is oxygen therapy protective? This review highlights our uncertainty on the topic. The authors motivate for further high quality randomised controlled trials on the subject. Two such trials are currently in development.

In conclusion, we are uncertain whether routine oxygen therapy reduces mortality in AMI patients. This review has been essential in changing perceptions regarding traditional oxygen therapy in heart attack patients.

Section editors: M. McCaul, T. Kredo

OXYGEN THERAPY FOR ACUTE MYOCARDIAL INFARCTION

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Background
Oxygen (O₂) is widely used in people with acute myocardial infarction (AMI) although it has been suggested it may do more harm than good. Previous systematic reviews have concluded that there was insufficient evidence to know whether oxygen reduced, increased or had no effect on heart ischaemia or infarct size, as did our original Cochrane review on this topic in 2010. The wide dissemination of the lack of evidence to support this widely-used intervention since 2010 may stimulate the needed trials of oxygen therapy, and it is therefore important that this review is updated regularly.

Objectives
To review the evidence from randomised controlled trials to establish whether routine use of inhaled oxygen in acute myocardial infarction (AMI) improves patient-centred outcomes, in particular pain and death.

Search Methods
The following bibliographic databases were searched last in July 2012: the Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library), MEDLINE (OVID), EMBASE (OVID), CINAHL (EBSCO) and Web of Science (ISI). LILACS (Latin American and Caribbean Health Sciences Literature) and PASCAL were last searched in May 2013. We also contacted experts to identify any studies. We applied no language restrictions.

Selection Criteria
Randomised controlled trials of people with suspected or proven AMI (ST-segment elevation myocardial infarction (STEMI) or non-STEMI), less than 24 hours after onset, in which the intervention was inhaled oxygen (at normal pressure) compared to air and regardless of co-therapies provided these were the same in both arms of the trial.

Data Collection and Analysis
Two authors independently reviewed the titles and abstracts of identified studies to see if they met the inclusion criteria, and independently undertook the data extraction. The quality of studies and the risk of bias were assessed according to guidance in the Cochrane Handbook. The primary outcomes were death, pain and complications. The measure of effect used was the risk ratio (RR) with a 95% confidence interval (CI).

Main Results
The updated search identified one new trial. In total, four trials involving 430 participants were included and 17 deaths occurred. The pooled RR of death was 2.05 (95% CI 0.75 to 5.58) in an intention-to-treat analysis and 2.11 (95% CI 0.78 to 5.68) in participants with confirmed AMI. While suggestive of harm, the small number of deaths recorded means that this could be a chance occurrence. Pain was measured by analgesic use. The pooled RR for the use of analgesics was 0.97 (95% CI 0.78 to 1.20).

Authors’ Conclusions
There is no conclusive evidence from randomised controlled trials to support the routine use of inhaled oxygen in people with AMI. A definitive randomised controlled trial is urgently required, given the mismatch between trial evidence suggestive of possible harm from routine oxygen use and recommendations for its use in clinical practice guidelines.

Plain Language Summary
Many people who are having a heart attack are routinely given oxygen to breathe. We looked for the evidence to support this practice by searching for randomised controlled trials that compared the outcomes for people given oxygen to the outcomes for those given normal air to breathe. We were primarily interested in seeing whether there was a difference in the number of people who died, but we also looked at whether administering oxygen reduced pain.

We found four randomised controlled trials that compared one group given oxygen to another
group given air. These trials involved a total of 430 participants of whom 17 died. In that group, more than twice as many people known to have been given oxygen died compared to those known to have been given air. However, because the trials had few participants and few deaths, this result does not necessarily mean that giving oxygen increases the risk of death. The difference in numbers may have occurred simply by chance. Nonetheless, since the evidence suggests that oxygen may in fact be harmful, we think it is important to evaluate this widely-used treatment in a large trial as soon as possible, to make sure that current practice is not causing harm to people who have had a heart attack.
ANALGESIA IN THE RESOURCE LIMITED SETTING: MORPHINE OR KETAMINE?

An unblinded cluster-randomized controlled trial was performed in the low-resource setting of Quang Tri province, Vietnam to determine the efficacy and side-effects of prehospital Morphine vs. Ketamine administration among trauma patients in need of analgesia. The province was divided into two sectors that alternated monthly between Ketamine and Morphine analgesia. The Visual Analogue Scale (VAS) was used to rate levels of pain and secondary measures of respiratory rate and systolic blood pressure were also measured. After application of the exclusion criteria 169 patients were randomised and analysed in the Ketamine group while 139 patients were included in the Morphine group. Morphine produced a mean decrease in pain as measured by the VAS of 3.1 while Ketamine produced a mean decrease of 3.5 (these differences did not reach statistical significance). Ketamine was found to have a lower incidence of nausea and vomiting than Morphine (5% vs. 19%), but had a higher incidence of hallucinations and agitation (11% vs. 1.5%). The mean change in blood pressure was also greater in the Ketamine group when compared to the Morphine group (9.3mmHg vs. 4.8mmHg); this difference did also not reach statistical significance.

This study shows that prehospital Ketamine is a safe analgesic option in the resource limited setting that has similar efficacy to Morphine but carries a lower risk of vomiting (and aspiration). It is also preferable in the hypotensive patient population.


MECHANICALLY ASSISTED CPR EQUIVALENT TO MANUAL CPR

A multisite unblinded randomised controlled trial was conducted comparing integrated automated load distributing band CPR (iA-CPR) with high-quality manual CPR (M-CPR) in out-of hospital cardiac arrest patients. 4753 patients were randomised and the primary outcome, survival to hospital discharge, showed no significant difference between the two groups 1.06 (95%CI 0.83-1.37), meeting the criteria for equivalence. High-quality manual CPR is thus as good as its expensive counterpart, mechanically assisted CPR.

A systematic review and meta-analysis was conducted to investigate the efficacy of adrenaline in adult out-of-hospital cardiac arrest patients. Both randomised controlled trials and quasi-randomised controlled trial was included for review. A total of 14 RCTs met the review inclusion criteria and a meta-analysis was performed. Standard dose adrenaline (SDA) compared to high dose adrenaline (>1mg dose) found no survival differences at discharge (RR 1.04, 95%CI 0.74-1.96, p=0.46) and neurological outcome. SDA compared to adrenaline and vasopressin showed no differences in any outcomes (survival, ROSC or neurological). This meta-analysis included up to 12 246 patients. This systematic review shows there is no benefit of adrenaline in survival to discharge or neurological outcomes in pre-hospital adult patients.

INTERVIEW WITH THE
OPEN MEDICINE PROJECT OF SOUTH AFRICA

Jocelyn Park-Ross

At a time where smart phones, apps and tablets are becoming increasingly common-place in everyday existence, it is only natural for the technological boom to be flourishing in the medical field. From digital patient records replacing bulky patient files to medical apps ousting a large collection of expensive, heavy textbooks-these developments are in the spirit of open access and efficiency. The Open Medicine Project of South Africa’s (TOMPSA) Dr Katya Evans and Dr Yaseen Khan talk to Sanguine about their free app and how they are aiming to empower healthcare workers through free access to medical guidelines.

What is The Open Medicine Project of South Africa (TOMPSA)?

Yaseen: TOMPSA was started in 2012 and stands for The Open Medicine Project of South Africa. We aim to capacitate healthcare workers in the developing world using mobile technology. Our apps aim to provide local information needed by healthcare workers either through locally authored guidelines or clinical decision support tools to improve decisions made by healthcare workers on the frontline.

Tell me about the EMGuidance Project?

Yaseen: The EMGuidance project is an example of how a collaborative effort between local medical experts, health workers in the field, mobile app designers and developers, and the use of social media, can produce the most amazing mobile information support for frontline health workers in South Africa. Essentially EMGuidance, and TOMPSA, is premised on the fact that providing health workers with the right information in the right format through their phones will improve patient care.

TOMPSA and EMGuidance focuses on much needed local health and health system information, ranging from clinical guidance, to local referral pathway information, to directory information and local hospital and health system policy information. It packages and channels content which health workers would otherwise have searched for from various sources, such as universities, the department of health and professional societies into an easily accessible and growing repository of support information.

Where does the content from EM Guidance come from?

Katya: The primary core content is comprised of the Divisions of Emergency Medicine - UCT/ Stellenbosch Guidance books written by a variety of specialists in the industry (each guideline is referenced along with authors name) and endorsed by the African Federation of Emergency Medicine. In addition to this guideline book there are numerous other collaborations with industry leaders from various spheres that apply to emergency medicine ranging all the way from Hospice to Paediatric Burns Unit & ICU.
Why did TOMPSA choose to make apps as their medium for information? How are apps more useful than a website for example?

Yaseen: There are 5 billion mobile connections in the developing world yet only 2 billion people in the developing world have access to clean drinking water. Technically if we made sim cards that could make clean drinking water we could change the world forever. Mobile has this amazing power that if we can fully utilize could make a massive positive difference in the world. With Smartphones becoming cheaper everyday we are planning for the next 2-3 years where smartphones will be as ubiquitous as your basic feature phones. Apps are one of the best ways to allow users to interact with content, it can be accessed offline especially where internet connectivity is patchy and gives a much better user experience than a website. Apps are also easier to access on your phone and gives the user a sense of ownership of the app thereby increasing interactivity. TOMPSA’s apps allow users to download content and view content offline. In Rural South Africa, where mobile connectivity is poor, this provides the perfect platform to facilitate access to this content for health workers.

The app is constantly evolving, how do you interact with your users and who contributes to the app updates?

Katya: We post information about our updates on social media weekly, and users can post suggestions on our various pages. We communicate with our users via our Facebook page “EM Guidance - Tompsa”, via twitter @TOMP_SA and users are also welcome to email suggestions or collaboration ideas to kat@tompsa.co.za

How is the app relevant to EMS personnel?

Katya: EM Guidance is an excellent tool for EMS staff to keep in their pockets, from BLS level all the way to ALS and including students.

The bulk of the app is comprised of a “guidelines” section including sections on initial ventilator settings and intubation including quick reference notes on RSI drug doses, as well as topics ranging from snakebites, decompression illness, myocardial infarction, paediatric seizures and Tipt Toxicity! There is a dedicated EMS/Major Incident Management section with useful key information to keep in your pocket such as a guideline for patient handovers, METHANE report, Triage sieve & sort & command structures in major incidents.

A phone directory of useful phone numbers for EMS staff including poison centres, medical information hotlines, private & provincial hospitals and many more. Included in this section is the GPS coordinates & maps of all facilities! For now we have only loaded up Western Cape hospitals but we plan to do the remainder of South Africa and would appreciate any assistance from users who can help us with information and phone numbers of the facilities that they work in!

A “procedures” section of the app has instructional text, images and videos of common EMS skills performed to help refresh your memory. Some EMS calculators built into the app are GCS & NEXUS CSpine rule.

We would welcome anyone to contact us if you would like to discuss content ideas for the app that could help EMS staff further!

Can you tell me about some other / upcoming TOMPSA projects?

Yaseen: TOMPSA aims to identify gaps in information access, and clinical support for South African health workers. As has been done for Emergency Medicine, these gaps exist in other domains such as primary health care, paediatrics and maternal health care for example. TOMPSA aims to engage with frontline health workers, connect local content experts and institutions, use social media to drive collaborative input around these health and disease areas. TOMPSA is working on projects for TB, obstetrics and Gynaecology as well as HIV.

TOMPSA is all about involvement: what would you like to be your take home message for the readers of Sanguine?

We need as much support as we can get! We are faced with a mounting burden of disease and resources which cannot keep up. We need to find ways of working together to share our brainpower, capacity and information, and use what we have to tackle the problems we face. Improving patient care and outcomes is the ultimate goal of all of this, and we believe that technology is an excellent tool, but essentially only a medium, to channel a collective effort to achieve patient’s lives.

EMGuidance is available for both iOs and android users. To download the app, follow the link to the TOMPSA website:
http://tompsa.co.za/

Dr Katya Evans, content manager for the EMGuidance app, is employed by the Provincial Government of the Western Cape as an Emergency Medicine Registrar and is currently completing her MMED: Emergency Medicine at University of Cape Town.

Dr Yaseen Khan, co-founder and director of TOMPSA, (MBCHB (US) DipPEC (SA) Msc. Clin Epidemiology Student U.S.) works as an emergency room Doctor at Rondebosch Medical Centre.

Jocelyn Park-Ross is an Emergency Care Practitioner and Flight Paramedic at Air Mercy Service, Cape Town.